

Study Guide

For use with pages 458–461

GOAL Simplify radical expressions.**VOCABULARY**A radical expression is in **simplest form** when:

- No factor of the expression under the radical sign has any perfect square factor other than 1.
- There are no fractions under the radical sign, and no radical sign in the denominator of any fraction.

Product Property of Square Roots

$$\sqrt{ab} = \sqrt{a} \cdot \sqrt{b}, \text{ where } a \geq 0 \text{ and } b \geq 0$$

Quotient Property of Square Roots

$$\sqrt{\frac{a}{b}} = \frac{\sqrt{a}}{\sqrt{b}} \text{ where } a \geq 0 \text{ and } b > 0$$

EXAMPLE 1 Simplifying a Radical Expression

$$\sqrt{112} = \sqrt{16 \cdot 7}$$

Factor using greatest perfect square factor.

$$= \sqrt{16} \cdot \sqrt{7}$$

Product property of square roots

$$= 4\sqrt{7}$$

Simplify.

EXAMPLE 2 Simplifying a Variable Expression

$$\sqrt{72a^2} = \sqrt{36 \cdot 2 \cdot a^2}$$

Factor using greatest perfect square factor.

$$= \sqrt{36} \cdot \sqrt{2} \cdot \sqrt{a^2}$$

Product property of square roots

$$= 6 \cdot \sqrt{2} \cdot a$$

Simplify.

$$= 6a\sqrt{2}$$

Commutative property

Exercises for Examples 1 and 2

Simplify the expression.

1. $\sqrt{24}$

2. $\sqrt{300}$

3. $\sqrt{275}$

4. $-\sqrt{1000}$

5. $\sqrt{92y^2}$

6. $\sqrt{12x}$

7. $-\sqrt{18t}$

8. $-\sqrt{27k^2}$

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EXAMPLE 3 Simplifying a Radical Expression

$$\begin{aligned}\sqrt{\frac{45}{169}} &= \frac{\sqrt{45}}{\sqrt{169}} && \text{Quotient property of square roots} \\ &= \frac{3\sqrt{5}}{13} && \text{Simplify.}\end{aligned}$$

Exercises for Example 3

Simplify the expression.

$$\begin{array}{llll} 9. -\sqrt{\frac{40}{81x^2}} & 10. \sqrt{\frac{108}{10,000t^2}} & 11. -\sqrt{\frac{9h}{16}} & 12. -\sqrt{\frac{50a^2}{289}} \end{array}$$

EXAMPLE 4 Using Radical Expressions

The expression $\sqrt{\frac{2h}{g}}$ gives the time t (in seconds) that it takes an object to hit the ground when dropped from a height h and with acceleration due to gravity g . Use the expression to approximate the amount of time it takes a ball dropped from a height of 50 meters to hit the surface of the planet Mars, where the acceleration due to gravity is about 3.7 meters per second per second.

Solution

$$\begin{aligned}\sqrt{\frac{2h}{g}} &= \sqrt{\frac{2 \cdot 50}{3.7}} && \text{Substitute 50 for } h \text{ and 3.7 for } g. \\ &= \sqrt{\frac{100}{3.7}} && \text{Multiply.} \\ &= \frac{\sqrt{100}}{\sqrt{3.7}} && \text{Quotient property of square roots} \\ &= \frac{10}{\sqrt{3.7}} && \text{Evaluate square root of 100.} \\ &\approx 5 && \text{Approximate using a calculator.}\end{aligned}$$

Answer: It takes the ball about 5 seconds to hit the ground.**Exercise for Example 4**

- 13.** Use the information in Example 4 to find the approximate amount of time it takes a ball to hit the ground when dropped from a height of 50 meters on Earth, where the acceleration due to gravity is about 9.8 meters per second per second.